E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Safe Work Practices

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Electrical Safe Work Practices

Electrical Supply Systems

Generation

In Australia, the fixed electrical supply is produced by a complex network of power stations and substations, all interconnected via hundreds of thousands of kilometres of overhead and underground cable.

The source of electrical power is the **Power Station**.

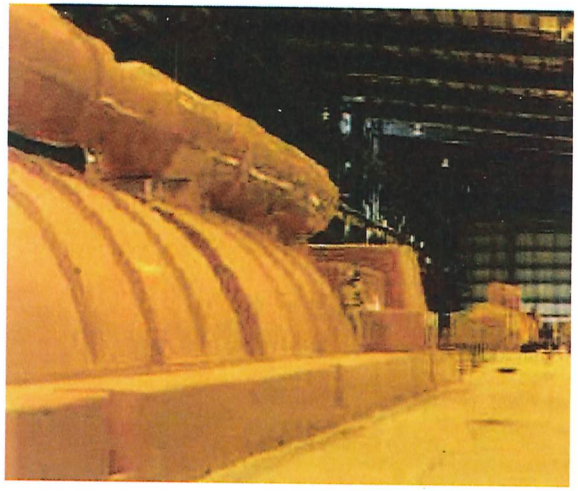
In New South Wales, 90% of our energy needs are supplied by burning **coal**, which is used to heat water to create steam.

The steam is fed into a turbine which drives an electrical generator. Some of these generators are capable of producing up to 660 million watts of power.

Modern power stations can have up to **four** of these generators.

Typical generator output voltages range from 11,000 volts to 23,000 volts. The output voltage is three-phase (3 Φ).

There are a number of **Generating Authorities** in NSW that are responsible for generating electricity.



660 MW Generating Unit

Transmission

Before leaving the power station, the electrical energy passes through a **transformer** where it is stepped up to a **higher voltage** level.

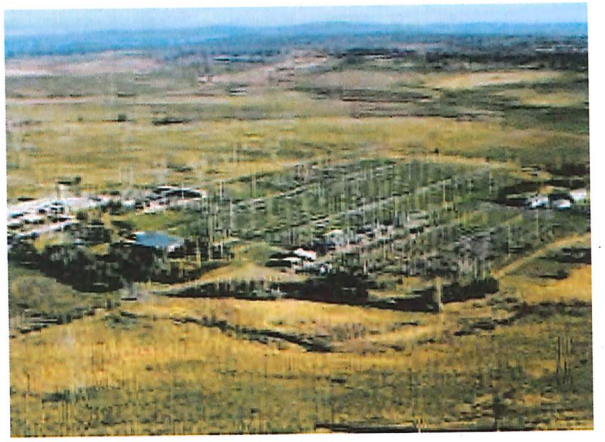
Increasing the voltage reduces the supply current, which helps to **reduce power losses** during transmission.

High voltage lines for **primary transmission** typically operate at 330,000 volts and 500,000 volts and run throughout the countryside supported by large transmission towers.

In NSW, the transmission system is managed by ***TransGrid***.

Transmission Centres and Regional Substations are located throughout the *TransGrid*network to interconnect the power stations, ensuring a more reliable system.

The primary transmission voltage is stepped down to 132,000 volts and 66,000 volts for secondary transmission to local **Electricity Distributors**.



Transmission Centre - Yass, NSW

High Voltage Distribution

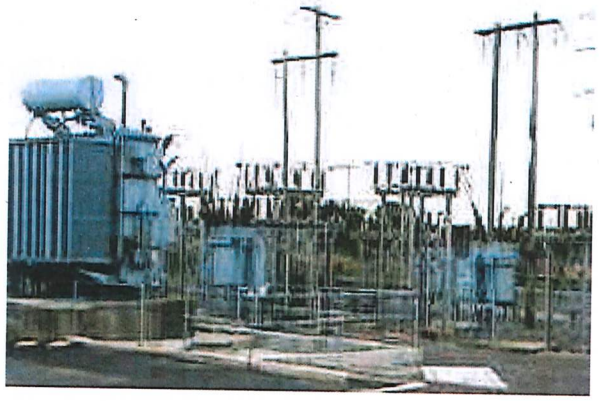
Electricity Distributors in NSW receive supply at secondary transmission voltage levels to a select number of **Zone Substations**.

At this point the voltage is stepped down to 33,000 volts and 11,000 volts for both **sub-transmission** and **high voltage distribution**.

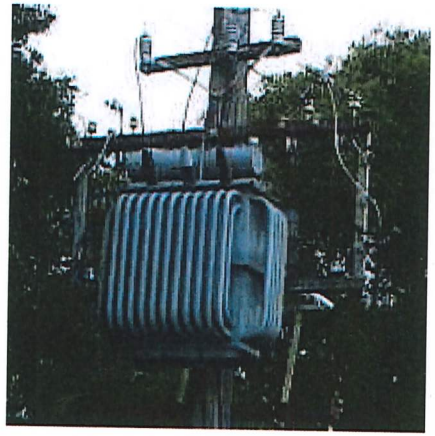
The 33,000 volt **sub-transmission** system is used to interconnect between zone substations belonging to the distributor. As with *TransGrid's* system, this is to improve system reliability.

The 11,000 volt **high voltage distribution** system supplies **distribution transformers**. In residential areas these transformers are usually located on the street.

For bulk supply customers such as large industrial sites and shopping centres, distribution transformers are often located on the customers premises.



Zone Substation - EnergyAustralia

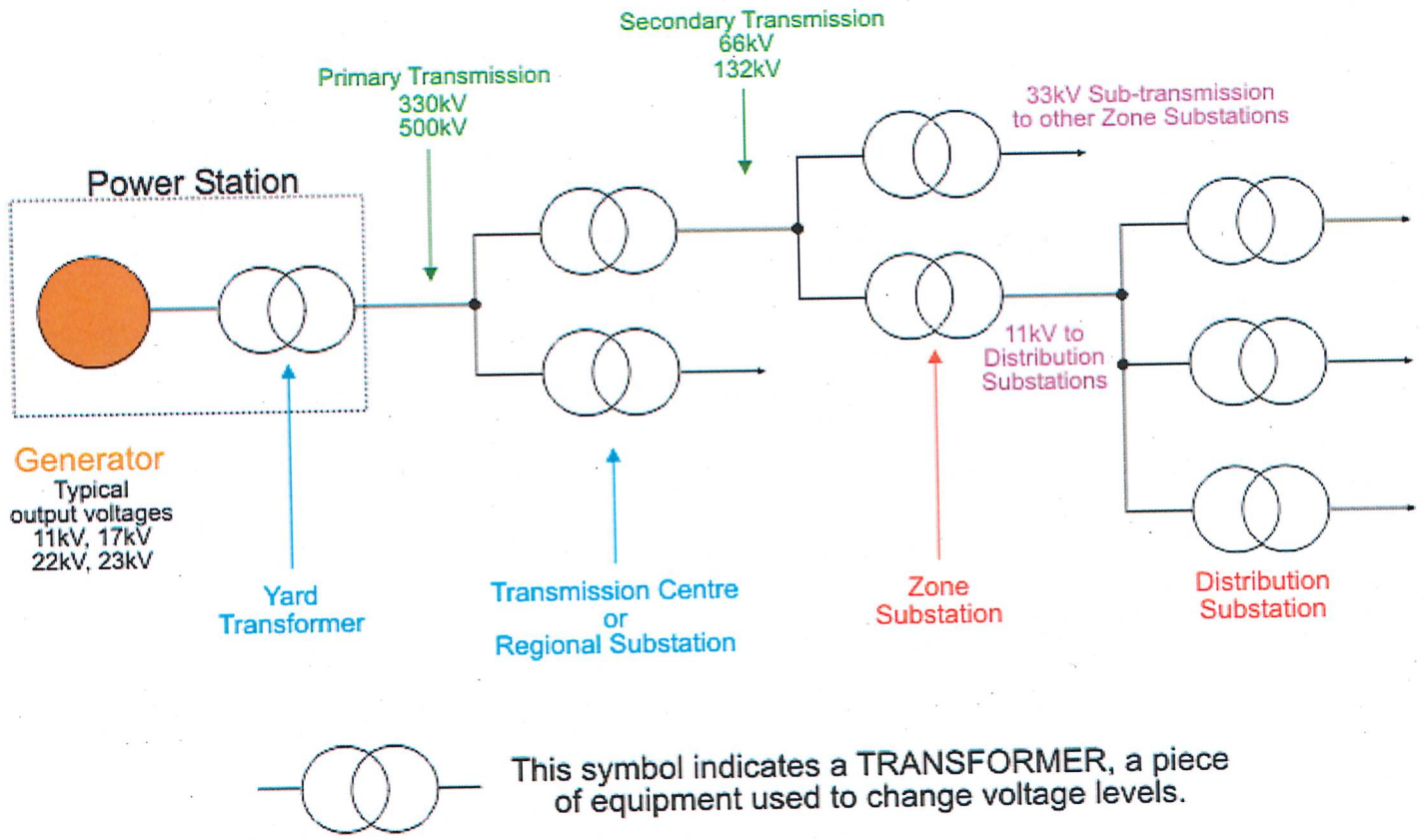


Low Voltage Distribution Transformer - Pole Mounted
Energy Australia

Low Voltage Distribution Transformer - Kiosk Type
Energy Australia

Activity

Complete the diagram in your workbook from the details given in the following graphic.



Low Voltage Distribution

At the low voltage distribution substation, **11,000 volt three phase (11kV 3Φ)** is fed into the **primary** side of the transformer. This is changed to a **230/400 volt 3Φ 4 wire** supply which is available at the **secondary** terminals of the transformer.

The **four wire** system consists of three **active** conductors, and one **neutral** conductor, and is distributed to consumers via the low voltage distribution system. This is done using aerial conductors on power poles, or via an underground cable.

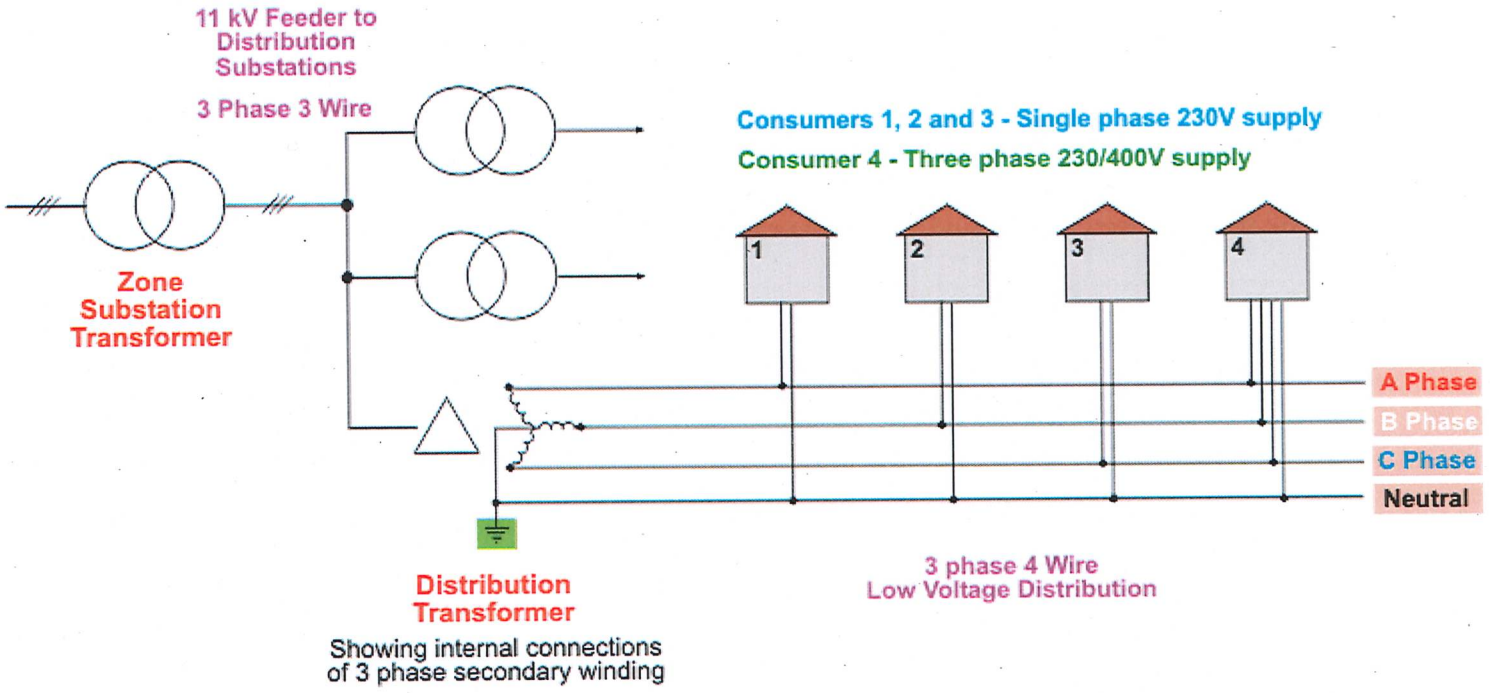
The three active conductors are designated:

- A phase, also known as red phase;
- B phase, also known as white phase; and
- C phase, also known as blue phase.

The voltages available in a 230/400V low voltage distribution system are as follows:

Phase Voltages	Line Voltages
A Phase to Neutral - **230V**	A Phase to B Phase - **400V**
B Phase to Neutral - **230V**	B Phase to C Phase - **400V**
C Phase to Neutral - **230V**	C Phase to A Phase - **400V**

Note: A phase voltage of 230V also exists between each phase and **earth.** This is because the supply neutral is connected to earth at the distribution transformer (see below).



The low voltage **source of supply** is the secondary winding of the distribution transformer.

Each consumer is supplied with one, two or three phases, depending on the **current demand** of the installation and the **types of load** to be connected.

The **neutral conductor** is supplied to every installation regardless of the number of phases supplied.

The neutral conductor is connected to **earth** at the distribution transformer, at multiple points in the street, and also at each consumers installation. This gives rise to the name **Multiple Earthed Neutral System or M.E.N. System**, which is the standard earthing system used in Australia for low voltage electrical installations.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Safe Work Practices

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Electrical Safe Work Practices

Low Voltage Installations

A **low voltage electrical installation** is deemed to commence at the **Point of Supply**. This is where the Electricity Distributor's low voltage distribution system connects to the customer's supply cables.

It is from the *Point of Supply* onwards that a licensed electrician is permitted to do electrical work.

Any work required to be done **beyond** the *Point of Supply* (i.e. in the Electricity Distributors network) requires special training and authorisation by the Distributor concerned.

Single Phase Installations

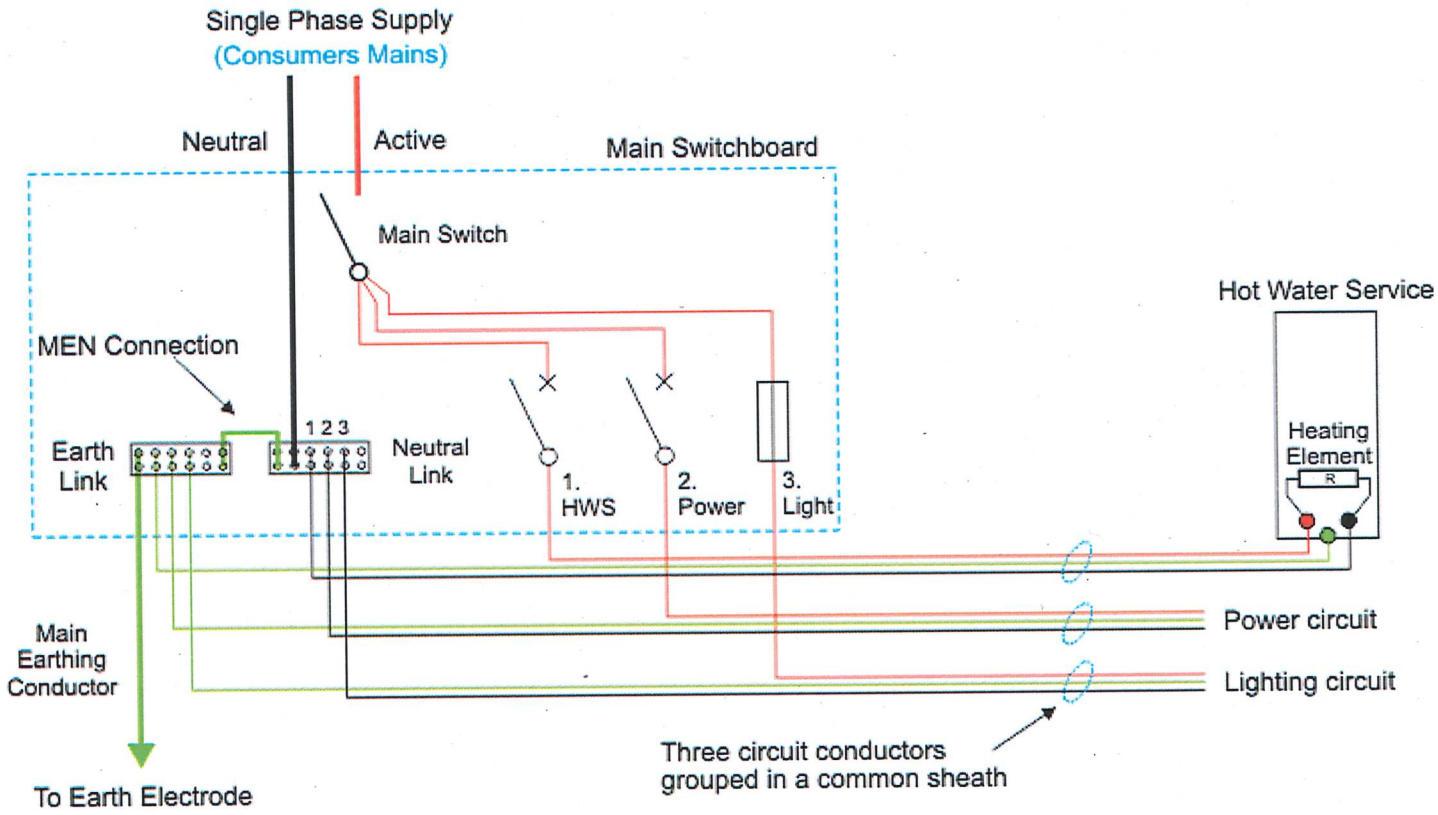
The most simple of all electrical installations is the **single phase installation**.

Most domestic residences are supplied with single phase, unless there's equipment to be installed that requires a multiphase supply (e.g. ducted air conditioning).

The diagram below shows a simplified single phase installation.

Activity

Complete the diagram in your workbook from the details given in the following graphic.



- The main switchboard is where the **main switch** is located. Sometimes there is more than one main switch on the main switchboard. Notice how the main switch is a **single pole** device (i.e. it switches only one conductor). Where the supply is two or three phase, a **multi-pole** main switch is used.
- The cables supplying the main switchboard are usually called **consumers mains**.Sometimes, where installed underground, it may be called a service cable.
- AS/NZS 3000 defines a switchboard as "an assembly of circuit protection devices". The circuit protection devices in the installation above are the **circuit-breakers** supplying the power and hot water circuits, and the **fuse** supplying the lighting circuit.
- The circuits supplying the equipment are known as final subcircuits.

- The circuit protection device is connected in the **phase** or **active** conductor of the circuit.
- The supply neutral runs to a metal bar called a **neutral link**. This is where all of the circuit neutrals are connected to the supply neutral.
- Circuit earthing conductors terminate at an **earth bar** (or link) and connect to an **earth electrode** via the **main earthing conductor**.
- The purpose of the **M.E.N.** connection is to connect the earth link to the neutral link at the main switchboard. This connection provides a parallel path back to the source of supply for earth fault currents should they occur.

Low Voltage Reticulation in Larger Installations

In larger installations (typically **commercial** or **industrial**) there may be more than one switchboard installed.

In these situations, a **reticulation system** is used. This is the interconnection of switchboards via a cabling system to ensure adequate supply throughout the premises.

There will still only be **one main switchboard** where the supply enters the premises. Any additional switchboards are known as **distribution boards**.

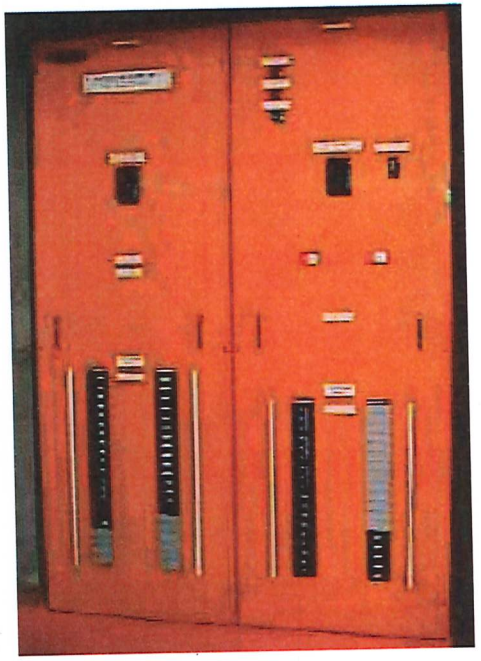
Cables supplying a distribution board are called **submains**.

The submains can run from the main switchboard to a distribution board, or they can run between two distribution boards.

It's important to note that the definitions **submain** and **final subcircuit** have nothing to do with the size of the cable. It's purely to do with the function of the circuits.

For example, a submain running from a Main Switchboard to a small distribution board might have a cable size of only 2.5mm².

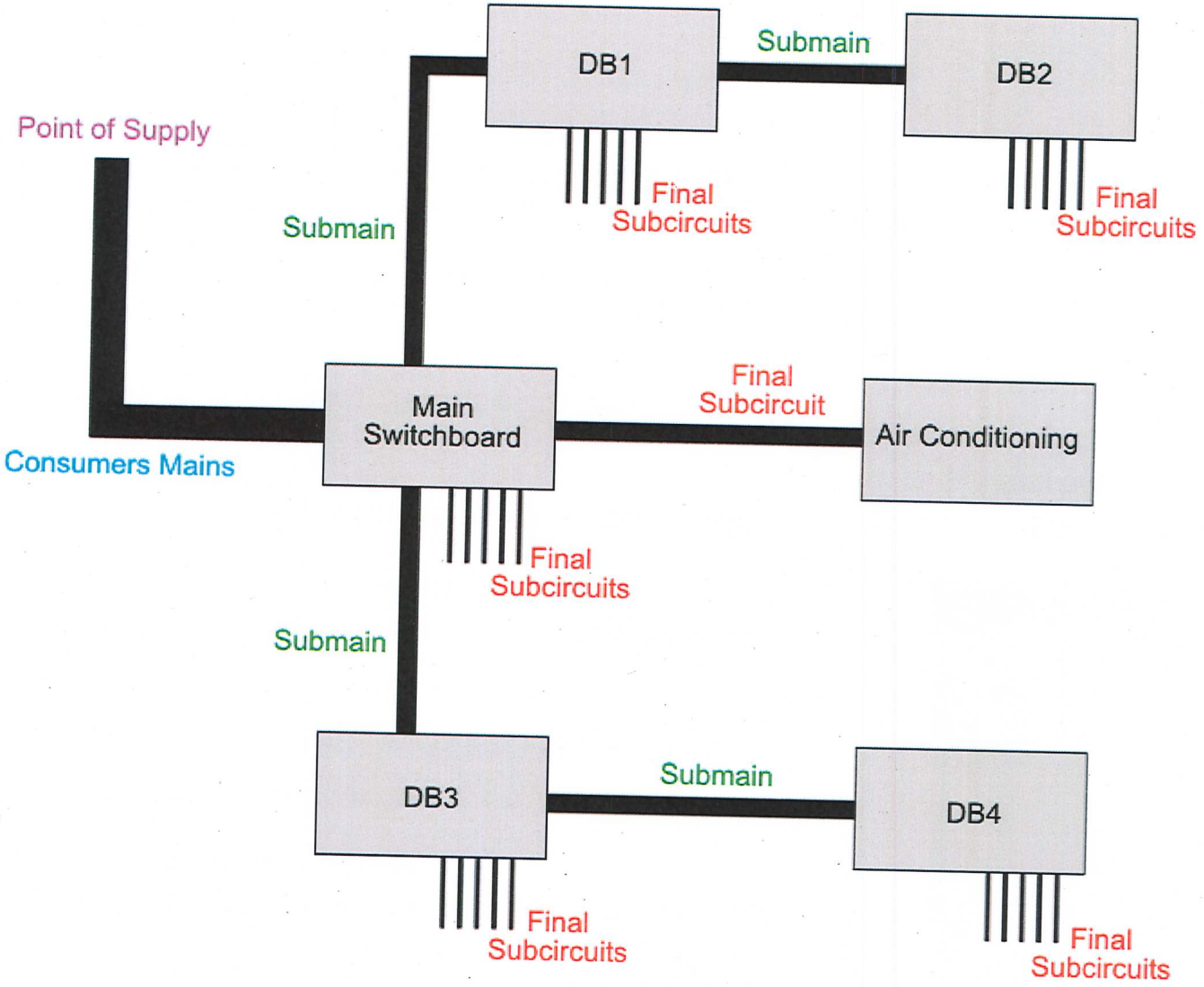
The same Main Switchboard could also be supplying a final subcircuit that runs to a furnace via 10mm² cable.



Distribution Board
in an Industrial Premises

Activity

Complete the diagram in your workbook from the details given in the following graphic.


DB1
Submain
DB2
Point of Supply
Final
Subcircuits
Final
Subcircuits
Submain
Main
Switchboard
Final
Subcircuit
Air Conditioning
Consumers Mains
Final
Subcircuits
Submain
DB3
Submain
DB4
Final
Subcircuits
Final
Subcircuits

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Safe Work Practices

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Electrical Safe Work Practices

Isolation and Protection Devices

When we consider turning electricity on or off, we usually think of it as simply a switching function. However, **AS/NZS 3000** deals with "switching" in a little more detail.

Clause 2.8.1 of **AS/NZS 3000** covers *"Devices for Isolation and Switching"*. In this clause, isolation and switching devices are classified according to the following functions...

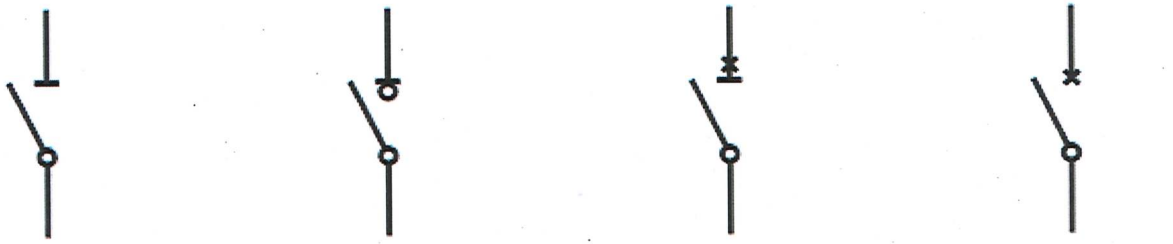
Isolation	Emergency	Mechanical Maintenance	Functional (or Control)

The purpose of an isolation device is to allow you to **manually disconnect** an electrical circuit or appliance from the supply, and typically to **maintain the device in the isolated position**, either by a lock, or by some other type of securing device.

While an electrical isolation device can usually perform all **four** of the functions listed above, you must remember that devices specifically for **emergency switching**, **mechanical maintenance** and **function switching** are not necessarily suitable as isolation devices...

- An "Emergency Stop" pushbutton is designed to be able to disconnect supply quickly in an emergency. However, supply can often be restored simply by pressing another button.
- Devices labelled "Motor Isolator" are often intended to prevent a motor from starting during mechanical maintenance, thus preventing physical injury. In many cases, the motor may still have an electrical supply connected (e.g. control circuits, heater circuits, etc).
- A simple example of a device for functional (or control) switching is a light switch in a house. This is not an isolation device. Even when the switch is in the off position, there may still be a power source at the light fitting. The switch has not isolated the circuit or equipment. It is simply used to control the light.

A device marked with one of the acceptable symbols below is deemed to comply with the AS3000 requirements for an isolation device. Also shown is the symbol for a circuit-breaker, which is **not** classed as an isolation device.



Isolator | On-load isolator | Circuit-breaker isolator | Circuit-breaker (not an isolator)

Typical Isolation Devices

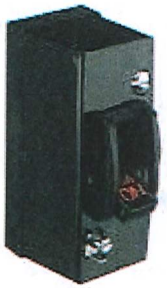
Isolation devices are usually arranged so that they can disconnect supply to:

- an entire installation (eg: a Main Switch)
- a portion of an installation (eg: a Submain Isolator)
- an individual circuit or piece of equipment (eg: a Hot Water Service)

Three Pole Isolating Switch (DIN Rail Mount)

This disconnection is a **physical break** in the circuit conductors.

Each switching contact in an isolator is called a **pole**. Isolators may be single, two, three or even four pole. The device chosen will depend on the number of conductors to be disconnected in the circuit. The contacts of two, three and four pole isolators are **operated simultaneously** via a single operating lever.

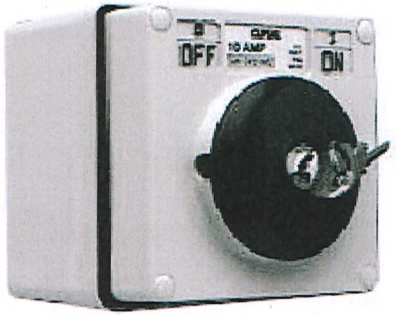


Single Pole Isolating Switch (Surface Mount)

Three Pole Isolating Switch (Surface Mount)

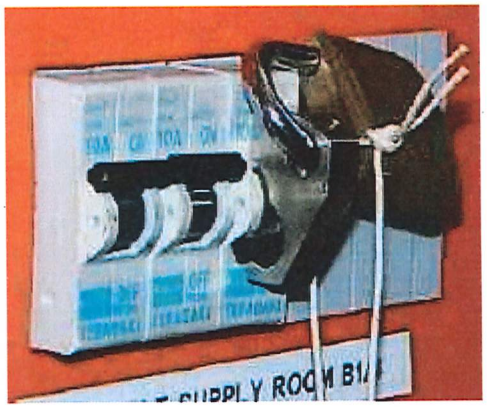
Two Pole Isolating Switch (DIN Rail Mount)

Some isolation devices provide facilities for securing the device in the open position. This can help to ensure that the isolator is not turned on accidentally. This is a requirement of the Wiring Rules when the isolator is out of view of the person working on the equipment.



Single-phase Isolator with locking facilities

Using Protection Devices for Isolation



Circuit protection devices such as circuit-breakers and fuses are used to protect electrical wiring from damage by **automatically** disconnecting an electrical circuit if an excess of current flows.

Where the manual operation of a circuit-breaker or withdrawal of a fuse carrier disconnects supply from a circuit, these devices may be used as the isolation device for the circuit (but take special note of the **WARNING** below).

As protection devices are primarily designed for circuit protection, they often don't have a means of securing the device in the open position. However, accessories are available to provide additional security.

A circuit-breaker **lock-dog** (shown on the right) allows a miniature circuit-breaker to be padlocked in the open position.

WARNING

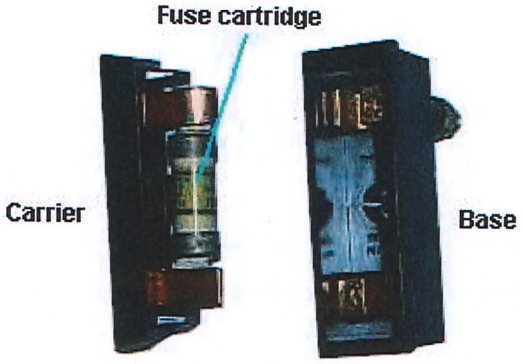
AS/NZS 3000 Clause 2.3.2.2.1(b) states that an isolation device "*...shall not be able to falsely indicate that the contacts are open.*"

Some miniature circuit-breakers can show the operating toggle in the open position even if the contacts are welded closed due to a fault. This type of circuit-breaker does not meet the AS3000 requirements for an isolation device.

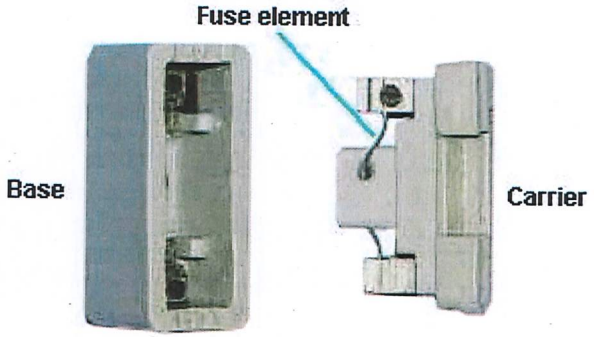
However, it **is** common practice in industry to use them for the isolation of final subcircuits. If you do, be aware of their limitations and be sure to test the circuit correctly before working (more on this later).

Many electrical installations, particularly older domestic installations, have **fuses** installed for circuit protection.

A complete fuse assembly consists of the **fuse cartridge** or **element** (the part that goes open-circuit if excess current flows), the **carrier** and the **base**.



HRC fuse carrier and base



Re-wirable fuse carrier and base

Where a fuse is to be used as the isolation device, the following safety guidelines should be followed:

- All load should be removed from the circuit before withdrawing the fuse carrier (i.e. turn all functional switches off).
- Once the fuse is withdrawn, an empty fuse carrier should be inserted into the fuse base. This prevents contact with live terminals and reduces the risk of someone accidentally inserting another fuse carrier.
- Where practicable, remove the circuit active from the load side of the fuse to further prevent livening up of the circuit.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Relationships in an Electrical Circuit

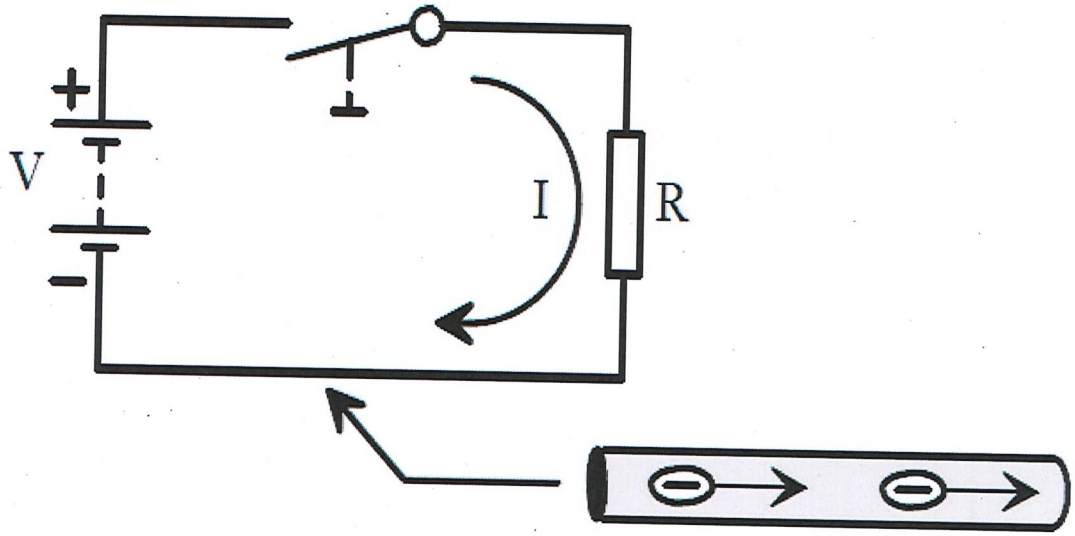
Mark as done

Relationships in an electrical Circuit

Alternating and Direct Current

Direct Current (DC)

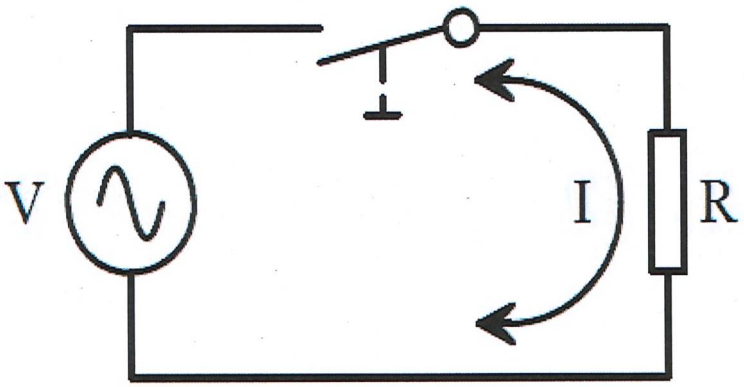
When a one directional emf, known as a **DC voltage**, is applied to a resistive circuit, a flow of electrons is established. This **electron flow takes place in one direction only**, from the negative terminal of the supply to the positive terminal.

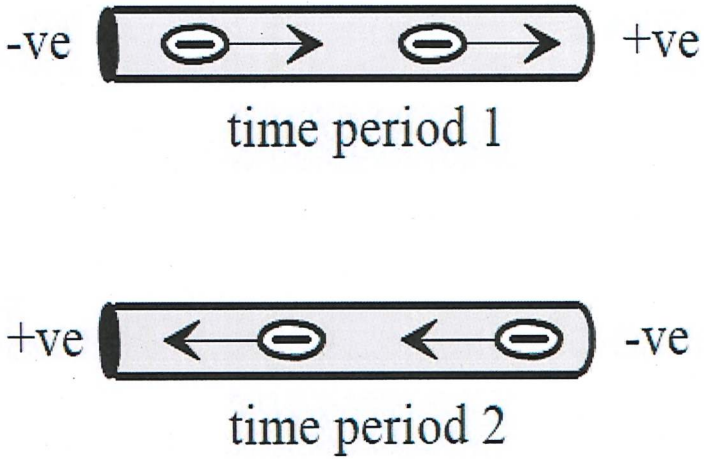


The electron flow is known as current flow and by convention is assumed to flow from the positive terminal of the supply to the negative terminal. As this current flows in one direction only, it is known as direct current and the voltage driving it is known as a DC voltage.

Alternating Current (AC)

An alternating current of electricity is defined as an electric current, which alternately reverses its direction in a circuit in a periodic manner. This means that an **alternating current changes its direction** around the circuit at regular intervals of time, usually much less than one second. An alternating current, considered in terms of electron theory, is the transfer of electrons first one way and then the other through the circuit, changing direction regularly at short intervals.





The number of electrons that pass any given cross-section of the circuit will vary from instant to instant. This must mean that the speed of the electrons is increased and then decreased, then increased in the reverse direction and then decreased, again reversed and so on. The force which produces this motion of electrons is the alternating electromotive force applied to the circuit, or as it is known the AC voltage.

V Differences Between AC and DC

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Relationships in an Electrical Circuit

Mark as done

Relationships in an electrical Circuit

Voltage, Current and Resistance

The three main terms used in electrical circuits are:

- Voltage - potential difference or Electrical Pressure - symbol V.
- Current - electrical flow - symbol I.
- Resistance - opposition to flow - symbol R.

The units for voltage, current and resistance are shown in the table with each unit's standard abbreviation.

Quantity	Symbol	Units	Abbreviation
voltage	V	volts	V
current	I	amperes	A
resistance	R	ohms	Ω

Voltage, current and resistance can also have values either larger or smaller than the standard units. For example, 1milliampere (mA) = 1/1000 A; 1kilovolt (kV) = 1000 V; 1megaohm = 1,000,000 ohms.

Multiples and sub-multiples

Large numbers such as 4,326,000 and small numbers, such as 0.000 237 are very hard to visualise and work with. The Metric System enables us to reduce these rather unmanageable numbers to much easier numbers between 1 and 100 together with a suitable power of 10. Multiples and Sub-Multiples are used to express these numbers.

Multiples of ten may be expressed as powers of ten in which the index is a whole number. Some of the multiples of ten are represented as follows:

$0.000001 = 10^{-6}$	$1 = 10^{0}$
$0.00001 = 10^{-5}$	$10 = 10^{1}$
$0.0001 = 10^{-4}$	$100 = 10^{2}$
$0.001 = 10^{-3}$	$1{,}000 = 10^{3}$
$0.01 = 10^{-2}$	$10{,}000 = 10^{4}$
$0.1 = 10^{-1}$	$100{,}000 = 10^{5}$
$1 = 10^{0}$	$1{,}000{,}000 = 10^{6}$

Standard notation of numbers - in standard notation, any number be it a decimal or whole number, is written as a number 1 and 10 times the appropriate power of ten. It is said to be in "standard notation".

Numbers Greater Than (≥) 1 Expressed in Standard Notation

Rule: To express a number ≥1 in standard notation, move the decimal point to the left until it lies between the first and second digits. Count the number of places the decimal point has moved from its original position - this will be the correct positive power of ten.

Example:

52,964 = 5.2964 x 104

37.286 = 3.7286 x 101 (often referred to as just 10)

Numbers Less Than (≤) 1 Expressed in Standard Notation:

Rule: To express a number less than 1 in standard notation, move the decimal point to the right until it lies between the first and second digits. Count the number of places the decimal point has moved from its original position - this will be the correct negative power of ten.

Example:

0.007 263 = 7.263 x 10 -3

0.1005 =1.005 x 10-1

Engineering Notation

Engineering notation differs from standard notation by restricting the **exponent** x **to multiples of 3**. Numbers in this form are easy to read out using prefixes and are used extensively in the Electrotechnology sector.

Name	Symbol	Power of Ten
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
unit	-	10^{0}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}

- ***Pico Unit (micromicro unit)***: The pico unit is one-millionth of one millionth of a unit.

Example: Thus 1 farad is equal to 1,000,000,000,000 or 10 -12 picofarads. (This is seldom used for units other than farads.) Symbol: pico - p (e.g. 56 pF).

- ***Nano Unit:*** The nano unit is one thousand millionth of a unit.

  Example: This unit is used in electronic timing circuits as a unit of time, the nanosecond and in capacitance measurement using nanofarads, i.e. thus 1 second is equal to 1,000,000,000 or 10 -9 nanoseconds. Symbol: nano - n (e.g. 60 ns).

- ***Micro Unit:*** The micro unit is one millionth of a unit.

  Example: This unit is commonly used in connection with volts, amperes, ohms, farads and henries, i.e. thus 1 ampere is equal to 1,000,000 µA. Symbol: micro - g (e.g. 10 µA).

- ***Milli Unit:*** The milli unit is one thousandth of a unit.

  Example: This unit is used in connection with volts, amperes, ohms, watts and henries, i.e. thus 1 volt is equal to 1,000 millivolts. Symbol: milli - m (e.g. 120 mV).

- ***Kilo Unit:*** The kilo unit is one thousand (1,000) basic units.

  Example: This unit is used in connection with volts, amperes, ohms and watts, i.e. thus 1 kW is equal to 10 3 watts. Symbol: kilo - k (e.g. 33 kV).

- ***Mega Unit:*** The mega unit is one million (1,000,000) basic units.

  Example: This unit is used in connection with volts, ohms and watts, i.e. thus 1 MΩ is equal to 106 ohms. Symbol: mega - M (e.g. 22 MΩ).

- ***Giga Unit:*** The giga unit is one thousand million (1,000,000,000) basic units.

  Example: This unit is used in connection with frequency and watts, i.e. thus 1 GHz is equal to 1 thousand million Hertz or 10 9 Hertz. Symbol: Giga - G (e.g. 104.9 GHz).

◀ Electrical Safe Work Practices

Jump to...

Magnetism and Electromagnetic Induction ▶

TAFE NSW would like to pay our respect and acknowledge Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of the Land, Rivers and Sea. We acknowledge and pay our respect to the Elders; past, present and emerging of all Nations.

Registered Training Organisation 90003 -- CRICOS Provider Number 00591E -- Higher Education Provider PRV12049

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E141 / E179 - Identify and Use Electrical Devices (Hunter)

Relationships in an Electrical Circuit

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Relationships in an electrical Circuit

Ohm's Law

Ohm's Law states that the current flowing through a resistance is:

- directly proportional to the potential difference between them
- inversely proportional to the resistance.

Ohm's law may be written as:

$$I = \frac{V}{R} \qquad V = IR \qquad R = \frac{V}{I}$$

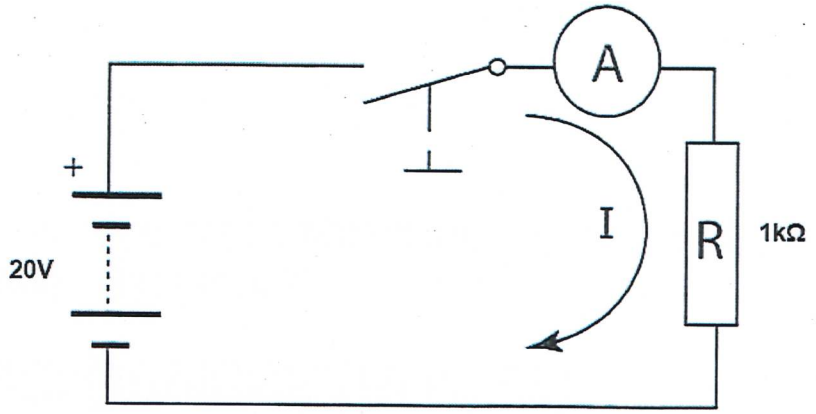
where:

V = voltage (volt) **R** = resistance (ohm) **I** = current (ampere)

Ohms Law equation expresses the current resulting from a particular voltage (*V*) and resistance (*R*). But you will just as often be given current (*I*) and resistance (*R*) and asked to find voltage (*V*). Or you may be given current (*I*) and voltage (*V*) and asked to find resistance (*R*).

Example 1:

Calculate the current taken by 1KΩ resistor when connected to a 20V supply



$$I = \frac{V}{R}$$

$$I = \frac{20}{1x10^3}$$

$$I = 0.02A \text{ or } 20mA$$

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Relationships in an Electrical Circuit

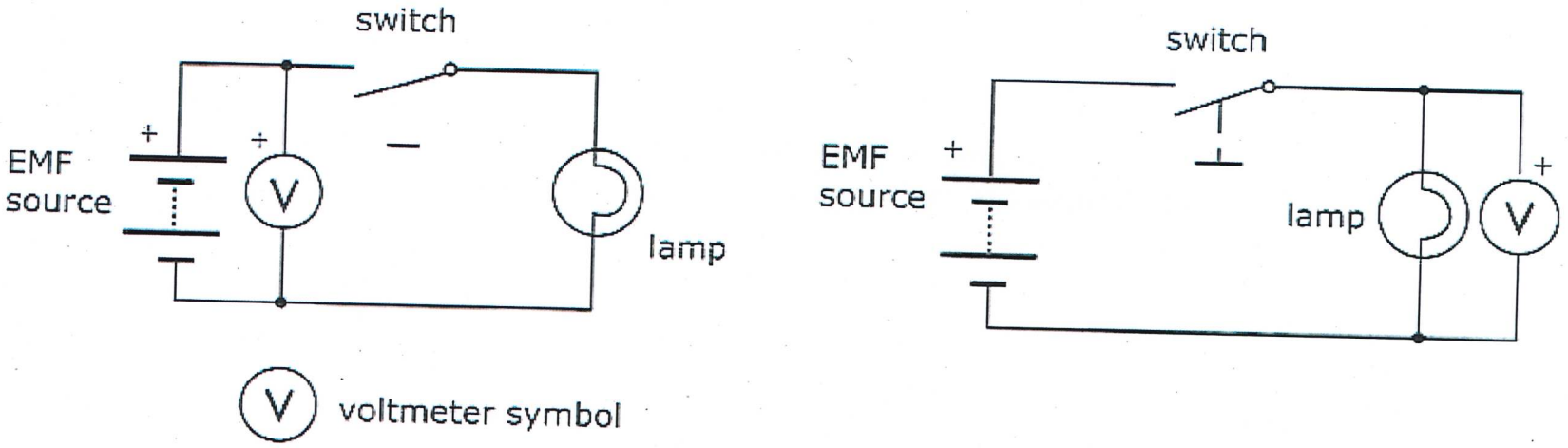
Mark as done

Relationships in an electrical Circuit

Measuring Voltage

To measure the electrical pressure between two points in a circuit, a voltmeter is used. The **voltmeter** is connected in **PARALLEL** with the component or supply where the electrical pressure is required to be measured as shown below.

Note: The polarity of the voltmeter, ie: +to +terminals, -to -terminals.

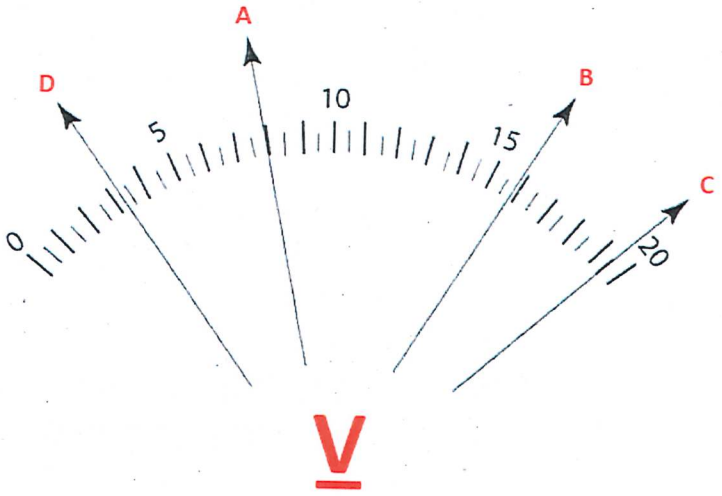


Voltmeter Connection

Voltmeter Measurement

A typical analogue scale of a voltmeter is shown on the right. The value of voltage when the pointer is at **Position A would be 8 V** (using the 20 V scale).

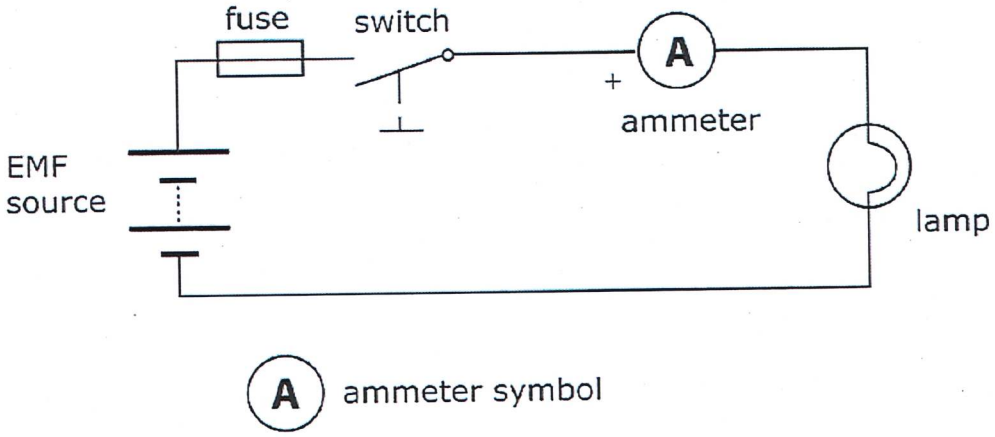
- Position B: **15.8v**



Typical Analogue Voltmeter Scale

Measuring Current

To measure the electrical current flow in a circuit, an ammeter is used. The **ammeter** is connected in **SERIES** with the load as shown below.

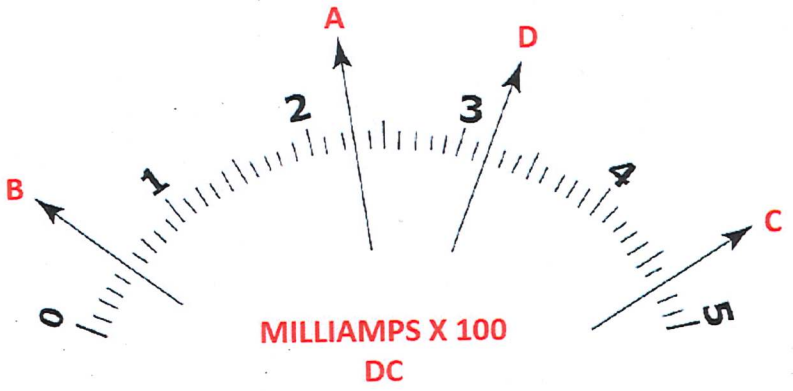


Ammeter Connection

Ammeter Measurement

To read the ammeter, the typical analogue scale of an ammeter is shown on the right. The value of current when the pointer is at **Position A would be 230 mA** (milliamperes), or 0.23 A.

- Position B: **50mA or 0.05A**



Typical Analogue Ammeter Scale

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Relationships in an Electrical Circuit

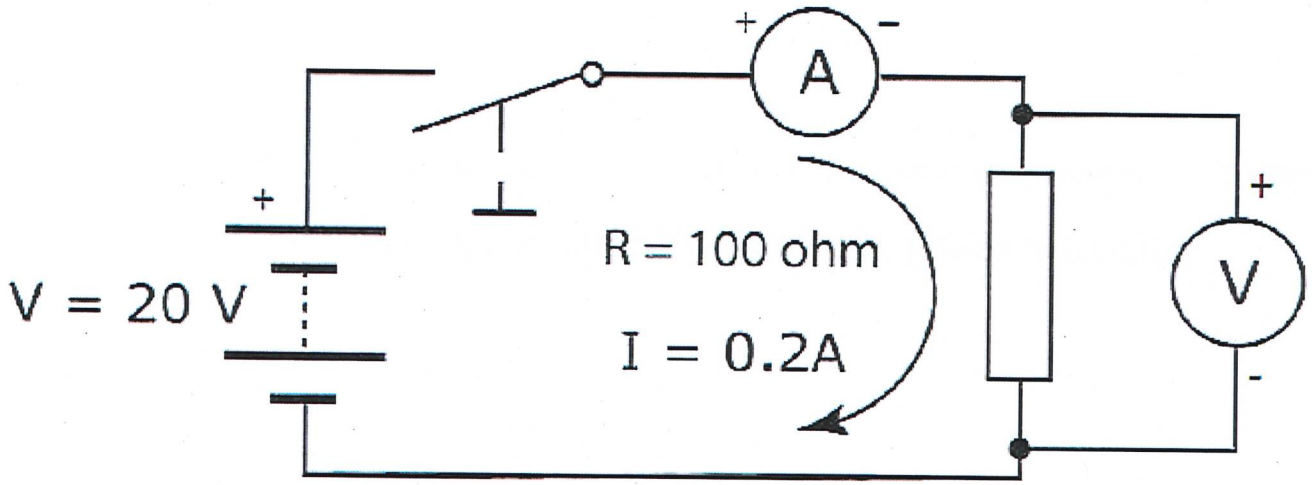
Mark as done

Relationships in an electrical Circuit

Direct Current - Ammeter and Voltmeter Connections

The **ammeter** is an instrument used to measure circuit **current**. The **ammeter** is connected in **series** with the circuit and it must have a low resistance so that its inclusion won't affect the resistance of the circuit.

The **voltmeter** is an instrument used to measure the **voltage** between any two points in a circuit. The **voltmeter** is connected across, or in **parallel** with the load being measured and must therefore have a very high resistance .

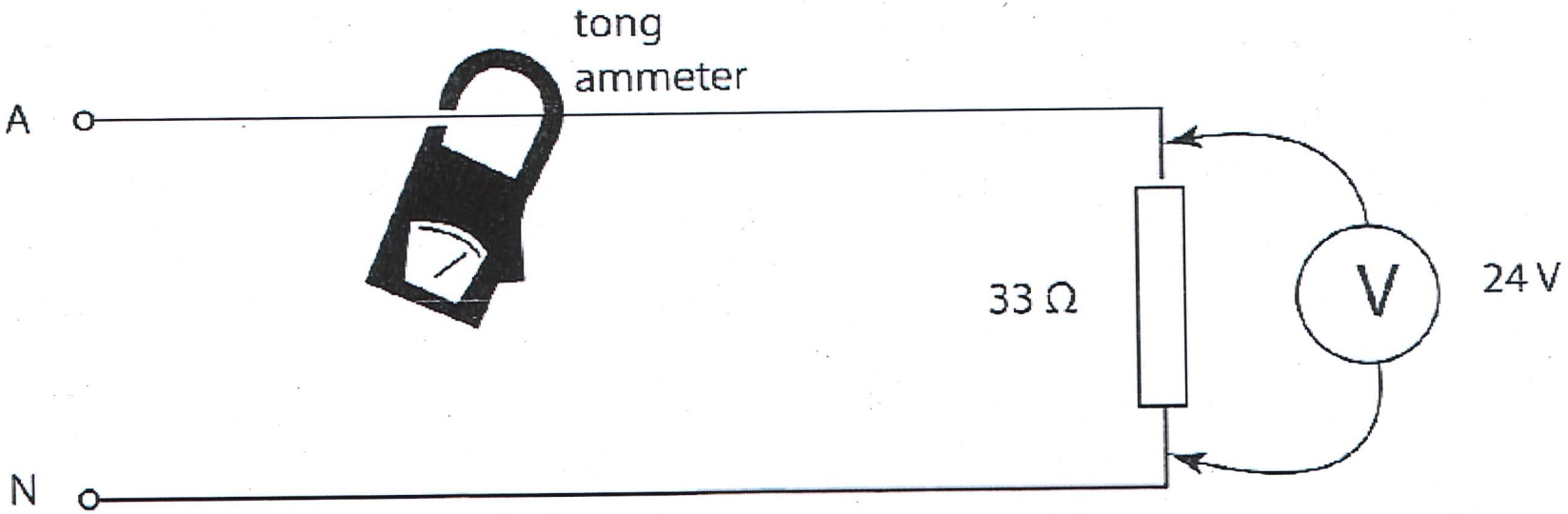


In the circuit above a **voltmeter** is connected to measure the **voltage** across a 100Ω resistor, with a **ammeter** connected in series to measure the **current** drawn by the 100Ω resistor when supplied by a 20V DC supply.

Alternating Current - Ammeter and Voltmeter Connections

The induction **tong-meter or clamp ammeter** is an instrument used to measure circuit **current**. The meter is clamped around a conductor.

The **voltmeter** is connected across, or in **parallel** with the load device being measured, as in a DC circuit.



In the circuit above a **voltmeter** is connected to measure the **voltage** across a 33Ω resistor, with a **clamp ammeter** around a conductor to measure the **current** drawn by the 33Ω resistor when supplied by a 24 V AC supply.

◀ Electrical Safe Work Practices

Jump to...

Magnetism and Electromagnetic Induction ▶

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Relationships in an Electrical Circuit

Mark as done

Relationships in an electrical Circuit

Power

Power is the **rate of doing work**, or equivalently, the rate of producing or expending energy. The symbol for power is P, and the unit is the watt (W). When energy is consumed at the rate of one joule per second, the power is one watt. Power can be illustrated by the fact that it may take several hours to dig a trench with hand tools, but an engine-driven backhoe could do the same job in a few minutes. We say the machine is more powerful, because it does more work in the same period of time.

Electrical power

Electrical power is the rate at which work is done as electric current flows through a circuit. The SI unit of power is the **watt.** Symbol W.

The power of an appliance is one of the most important parameters to specify. For example, to boil a litre of water using a 750 W electric jug might take three minutes. To boil the same amount of water using a 1500 W electric jug would take about half that time. Likewise, an air conditioner with insufficient power may fail to maintain a room at a comfortable temperature.

Power Rating of Equipment

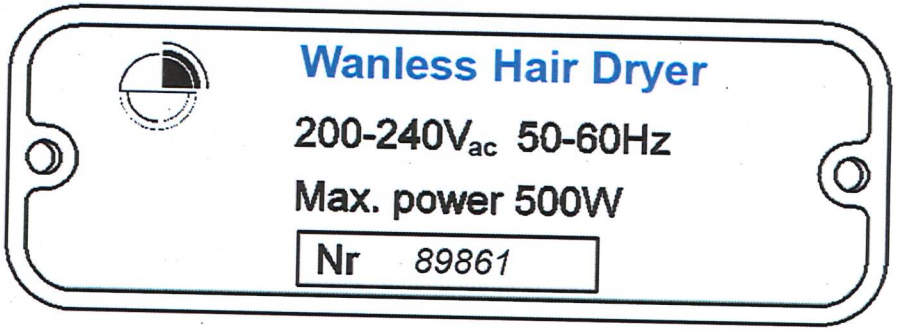
The power rating of an electrical appliance is important because it determines:

- the capability of doing the required work,
- the size of cable required for the current the appliance will draw,
- the running cost of the appliance.

Information relating to the electrical characteristics of an appliance is stamped on a manufacturer's nameplate which is attached to the appliance.

The information always includes the:

- **voltage** to which the equipment can be safely connected, both the type (**ac/dc**) and the value
- **maximum power** the appliance will consume.
- it is suitable for operation on 200-240 V alternating current with a **frequency** of 50-60 hertz,



Input and Output Power

Lamp wattages refer to the **input power**. However, this is not always the case. The power rating of electrical equipment may specify either:

- the input power drawn from the supply, or
- the output power.

The **input power** of an appliance is **usually quoted** when it is not practical to quote the output power. Common examples of such equipment are a **bread toaster**, a **hot-water service**, a **welding machine** or a **lamp**. In these examples electrical energy is being converted to heat, and this represents the 'final' state of the energy - the energy will not be converted to another form. It therefore makes sense to simply quote the power used by the device.

For industrial equipment such as transformers or motors, the **output power** is quoted, because this figure is required to make use of the device For example, it is important to know that mechanical output power that is provided by a **motor** in order to select a motor for a particular job. Note that where the output power is quoted, the electrical power that is actually used will be greater, because of the losses within the device.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Relationships in an Electrical Circuit

Mark as done

Relationships in an electrical Circuit

Electrical Power in Resistive Circuits

In a resistive circuit, electrical power is determined from the equation:

$$P = VI$$

where:

V = voltage (volt)

I = current (ampere)

P = power (watt)

To make sense of this equation, we can compare the electrical situation to a water pump that is lifting water uphill. The height through which the water is lifted is similar to the circuit voltage. The flow rate of water is similar to the current. But the power expended depends upon both the amount of liquid pumped, and the height. One way of understanding this principle is to think in terms of a **water circuit (analogy)**. Click here for an explanation of the the water analogy.

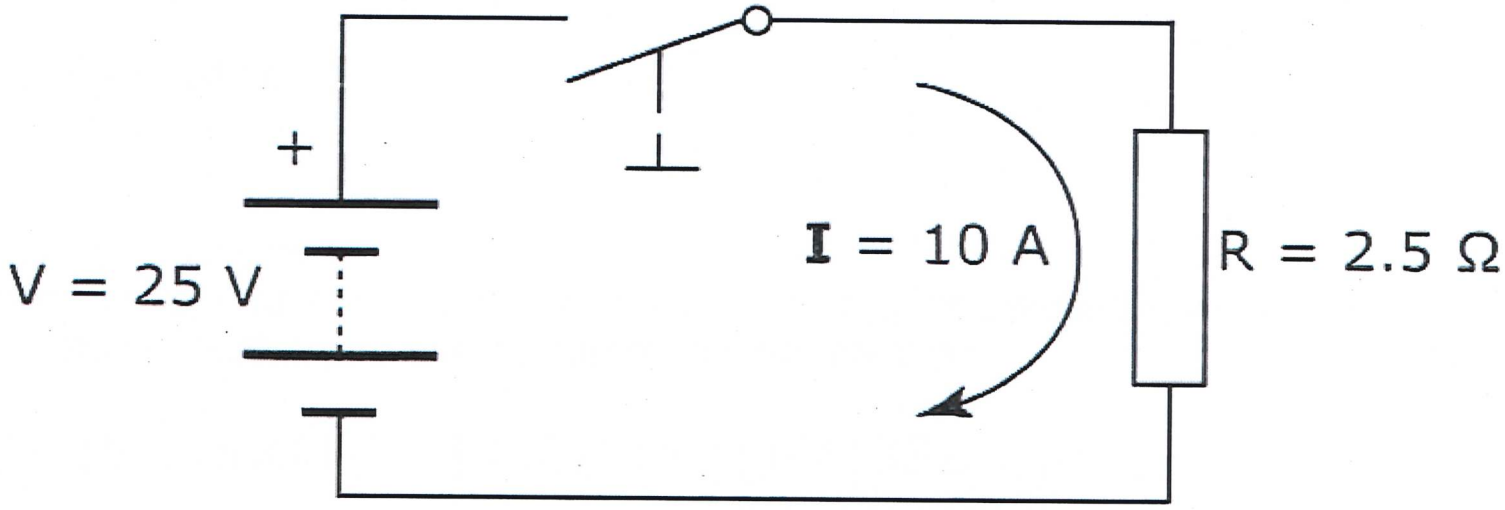
Example:

Calculate the power being dissipated in the 2.5Ω resistor.

$P = VI$

$P = 25 \; x \; 10$

$P = 250W$



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Magnetism and Electromagnetic Induction

Mark as done

Magnetism and Electromagnetic Induction

What is Magnetism?

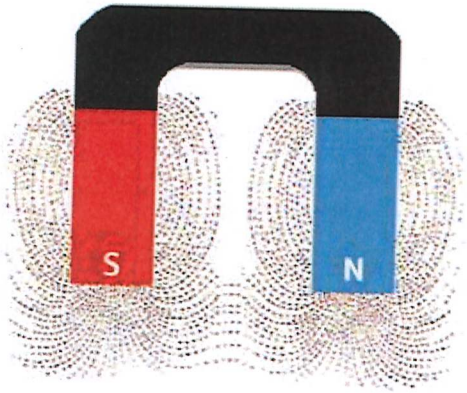
People have known about magnets for thousands of years and they've been using them practically, as compasses, for almost as long.

The ancient Greeks and Romans knew as well as we do that lodestone (an iron-rich mineral) can attract other pieces of iron, while the ancient Chinese were making magnetic compasses set in intricate wooden inlays for their practice of Feng Shui (the art of carefully arranging a room) thousands of years before interior designers came on board.

Science can sometimes be slow to catch up: we've only really learned how magnetism works in the last century, since the world inside atoms was first discovered and explored.

Three typical magnet shapes are the **bar magnet**, the **horseshoe magnet** and the **toroid magnet**.

Magnetic fields can penetrate through all kinds of materials, not just air. You probably have little notes stuck to the door of your refrigerator with brightly coloured magnets–so you can see that magnetic fields cut through paper. You may have done the trick where you use a magnet to pick up a long chain of paper clips, with each clip magnetising the next one along. That little experiment tells us that a magnetic field can penetrate through magnetic materials such as iron.



Horse Shoe Magnetic and Its Magnetic field

V What is a Magnet?

Types of Materials

Metals can be classified as either **ferrous** or **non-ferrous**...

- A ***ferrous*** metal is composed mainly of **iron**, resulting in the material having **magnetic** properties. Ferrous metals include carbon steel, alloy steel and cast iron.
- A ***non-ferrous*** metal is composed mainly of elements other than iron. Non-ferrous metals are **non-magnetic** and include copper, aluminium, lead, zinc, silver, gold and tungsten.

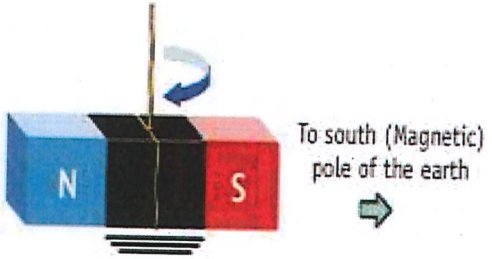
Bar and Horse Magnet With Iron Filings

Basic Magnetism Facts

There are six basic facts about how magnets behave:

1. A magnet has two ends called **poles**, one of which is called a north pole or north-seeking pole, while the other is called a south pole or south-seeking pole.
2. The north pole of one magnet attracts the south pole of a second magnet, while the north pole of one magnet repels the other magnet's north pole. So we have the common saying: **like poles repel, unlike poles attract**.
3. A magnet creates an invisible area of magnetism all around it called a **magnetic field**.
4. The north pole of a magnet points roughly toward Earth's north pole and vice-versa. That's because Earth itself contains magnetic materials and behaves like a gigantic magnet.
5. If you cut a bar magnet in half, you get two brand new, smaller magnets, each with its own north and south pole.

6. If you run a magnet a few times over an un-magnetised piece of a magnetic material (such as an iron nail), you can convert it into a magnet as well. This is called **magnetisation**.



South and North Seeking Poles

◀ Relationships in an Electrical Circuit

Jump to...

Electrical Accessories ▶

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E141 / E179 - Identify and Use Electrical Devices (Hunter)

Magnetism and Electromagnetic Induction

Mark as done

Magnetism and Electromagnetic Induction

Electromagnetism

The Homer Simpson or Mickey Mouse magnet that holds things to your refrigerator is a **permanent magnet;** it keeps hold of its magnetism all the time. Not all magnets work this way.

You can make a **temporary magnet** by passing electricity through a coil of wire wrapped around an iron nail (**solenoid**). Switch on the current and the nail becomes a magnet; switch it off again and the magnetism disappears.

This is the basic idea behind an electric chime doorbell. You make an electromagnet when you press the button, which pulls a hammer onto the chime bar–ding-dong! Temporary magnets like this are called **electromagnets**–magnets worked by electricity (**electromagnetism**).

V What is an electromagnet?

Like permanent magnets, temporary electromagnets come in different sizes and strengths. You can make an electromagnet powerful enough to pick up paperclips with a single 1.5-volt battery. Use a much bigger voltage to make a bigger electric current and you can build an electromagnet powerful enough to pick up a car. That's how scrapyard electromagnets work. The strength of an electromagnet depends on two main things: the size of the electric current you use and the number of times you coil the wire. Increase either or both of these and you get a more powerful electromagnet.

There are three basic types of electromagnets:

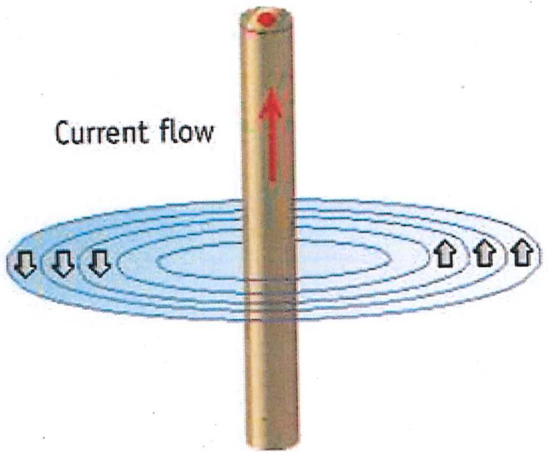
- ***Tractive types***, in which an electromagnet attracts an armature, as in a relay or contactor.
- ***Solenoid types***, where the coil surrounds a sliding plunger which is drawn into a coil.
- ***Lifting types***, where poles of electromagnet attract magnetic material for transportation.

Electromagnetic Induction

Electromagnets show that you can make magnetism using electricity. In fact, as European scientists discovered in the 19th century, every time an electric current flows in a wire, it generates a magnetic field.

The reverse is also true. Virtually all the electricity we use (with the exception of solar cells) is made by devices called generators. These use powerful magnets and coils of wire to produce electricity with the help of turbines, devices that capture kinetic energy from fluids that move past them (typically wind, water, or steam made from coal, oil, or nuclear power).

Simply speaking, putting a metal wire near a magnet (so the wire is inside the magnetic field) and moving the wire or moving the magnet so that the magnetic field inside the wire fluctuates will cause electricity to flow through the wire. Keep moving the wire or magnet and you'll make electricity continually. This transfer between magnetism and current flow is termed 'electromagnetic induction'.



Magnetic Field Around a Straight Connductor

V What is electromagnetic Induction?

The first person to explain this properly, in the mid-19th century, was a brilliant Scottish physicist named James Clerk Maxwell.

◀ Relationships in an Electrical Circuit

Jump to...

Electrical Accessories ▶

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E141 / E179 - Identify and Use Electrical Devices (Hunter)

Magnetism and Electromagnetic Induction

Mark as done

Magnetism and Electromagnetic Induction

What Use Are Magnets?

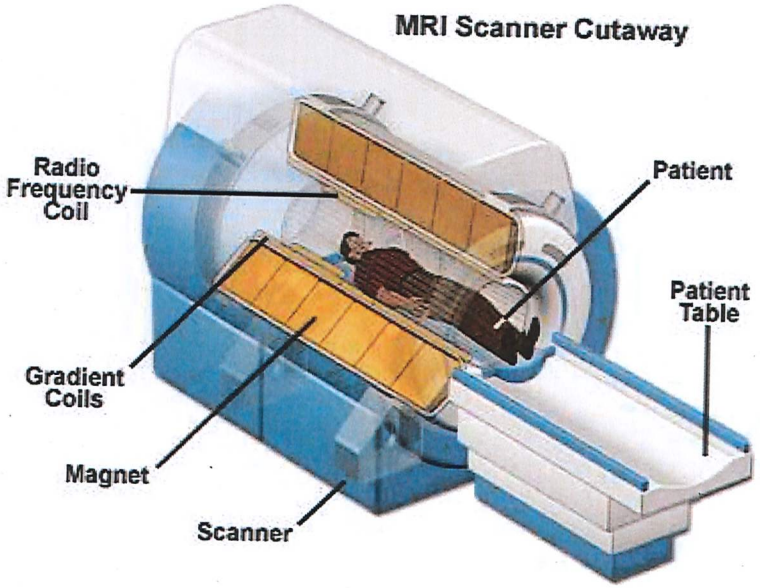
You might be surprised just how many things around you work by magnetism or electromagnetism.

Every electric appliance with an electric motor in it (everything from your electric toothbrush to your lawn mower) uses magnets to turn electricity into motion.

Motors use electricity to generate temporary magnetism in wire coils. The magnetic field thus produced pushes against the fixed field of a permanent magnet, spinning the inside part of the motor around at high speed. You can harness this spinning motion to drive all kinds of machines.

There are magnets in your refrigerator holding the door closed. Magnets read and write data (digital information) on your computer's hard drive and on cassette tapes in old-fashioned personal stereos. More magnets in your hi-fi loudspeakers or headphones help to turn stored music back into sounds you can hear.

If you're sick with a serious internal illness, you might have a type of body scan called 'Magnetic Resonance Imaging' (MRI), which draws the world beneath your skin using patterns of magnetic fields. Magnets are used to recycle your metal trash eg: steel food cans are strongly magnetic but aluminium drinks cans are not, so a magnet is an easy way to separate the two different metals.



V Every Day uses for Magnets

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Hazards

Mark as done

Electricity and Electrical Shock

Electrical Application Hazards

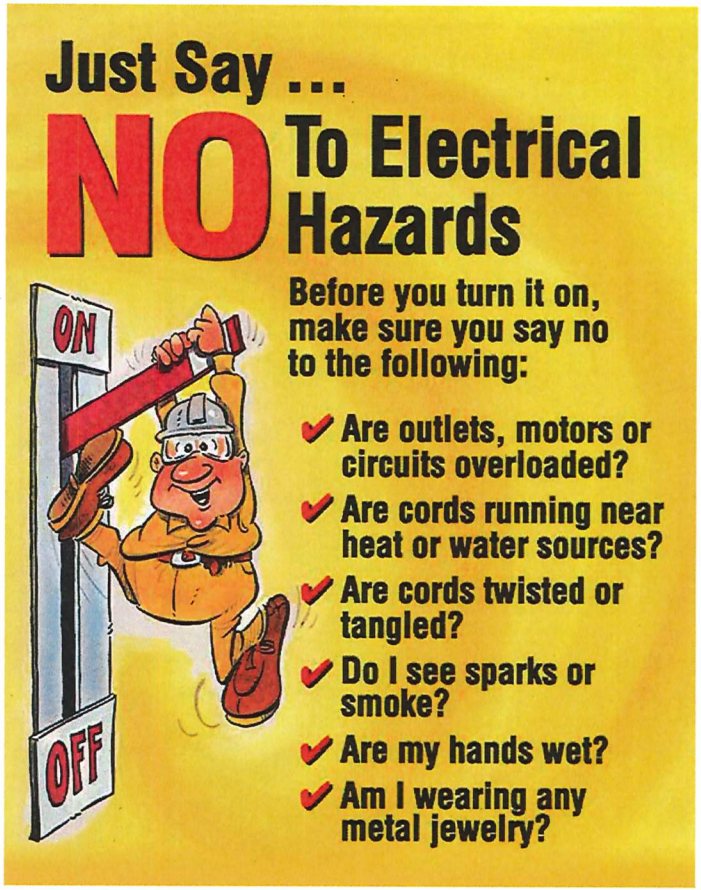
In some circumstances the risks of carrying out electrical work **near exposed energised parts** can be just as great as if the work were carried out on **energised electrical parts**. Electrical work on an **electrical installation or electrical equipment may pose a risk** of inadvertent contact with adjacent energised parts.

Where it is **reasonably practicable** to do so, turn off the power to the adjacent parts to eliminate the risk.

Where turning off the power is not reasonably practicable, you need to **minimise the risk**. This may involve a single control measure or a combination of two or more different controls.

The following factors may be taken into account in assessing risks:

- Type of work carried out and tools or equipment used
- Proximity of the work to energised parts
- The types of tools and equipment used in the work, particularly the conductive properties of tools
- Environmental conditions such as confined space, wet surfaces or unfavourable weather
- Assessing the need to repair equipment while it remains energised, for example cleaning a low voltage switch room
- Work that may impose additional risks, for example welding or grinding that could damage adjacent electrical lines or equipment



V [SafeWork NSW - Electrical Safety]

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Hazards

Mark as done

Electricity and Electrical Shock

Electricity and Electrical Shock

The world around us consists of substances we can see, smell, taste and feel. All of these substances are made up of ***atoms***, a combination of ***protons,neutrons,*** and ***electrons.*** If an external supply of ***electrons*** are forced into a substance, the electrons that are already in the substance can be forced to move through it.

In electrical terms:

- Voltage is the electrical pressure caused by the external supply of electrons
- Current is the actual movement of electrons through the substance

Another term, the **Resistance** of a substance, relates to how easily electrons can pass through the substance.

Some materials have a **low resistance** and are called **conductors** of electricity. Examples include copper, aluminium, and steel.

Other materials have a relatively **high resistance** to current flow and are called electrical **insulators**. Some common insulating materials include plastic, rubber and dry timber.

It should be remembered that even insulators will conduct electric current if the voltage is high enough

Effects of Electric Current

Electric current exists in two forms:

- ***DC*** or ***Direct Current*** - where electrons flow in one direction only and are usually flowing at a steady rate. A car battery is a typical DC supply.
- ***AC*** or ***Alternating Current*** - where electrons are continuously changing their direction of flow. Your house is supplied with AC, and the electrons in the wiring change direction every 0.01 of a second.

Neither is more or less dangerous than the other, with both having specific effects on the human body. These include:

- **Muscle Spasm** - The cycling nature of AC tends to cause muscles to spasm. DC does not cycle and tends to jolt the muscle.

- **Breathing Difficulties** - Due to the clamping of muscles and the associated pressure on the lungs.
- **Burns** - Usually due to arcing (ionisation of the air) when a piece of electrical equipment explodes.
- **Tissue Damage** - When an electric shock occurs, it often leaves only a small entry and exit hole in the skin. However, internal body tissue and organs may have been badly damaged and medical attention should be obtained immediately.
- **Ventricular Fibrillation** - A term used to describe the interruption of the normal rhythm of the heart. If this occurs, first aid is required immediately. This condition can occur with a current as low as 50 milliamps on a normally healthy person.

V Stay Safe in the Workplace

Voltage

While it's the current that causes the major injury from electric shock, it's the voltage that actually drives the current through the body. The higher the voltage, the more pressure there is to push electrons through the body.

Standard voltage classifications in Australia are:

- **Extra-Low Voltage (ELV)** - up to 50V a.c. or 120V d.c.
- **Low Voltage (LV)** - greater than ELV and up to 1000V a.c. or 1500V d.c.
- **High Voltage (HV)** - greater than 1000V a.c. or 1500V d.c.

Generally speaking, the **HIGHER THE VOLTAGE**, the **GREATER THE RISK** of electric shock.

That's not to say however that ELV isn't dangerous! Under certain conditions (e.g. a damp environment), ELV also has the capacity to injure, or even kill. For example, a 120V battery can have the capacity to deliver several hundred amps if the terminals were short circuited, resulting in horrific flash burns for anyone standing too close.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Accessories

Mark as done

Electrical Accessories

Overview of Electrical Accessories

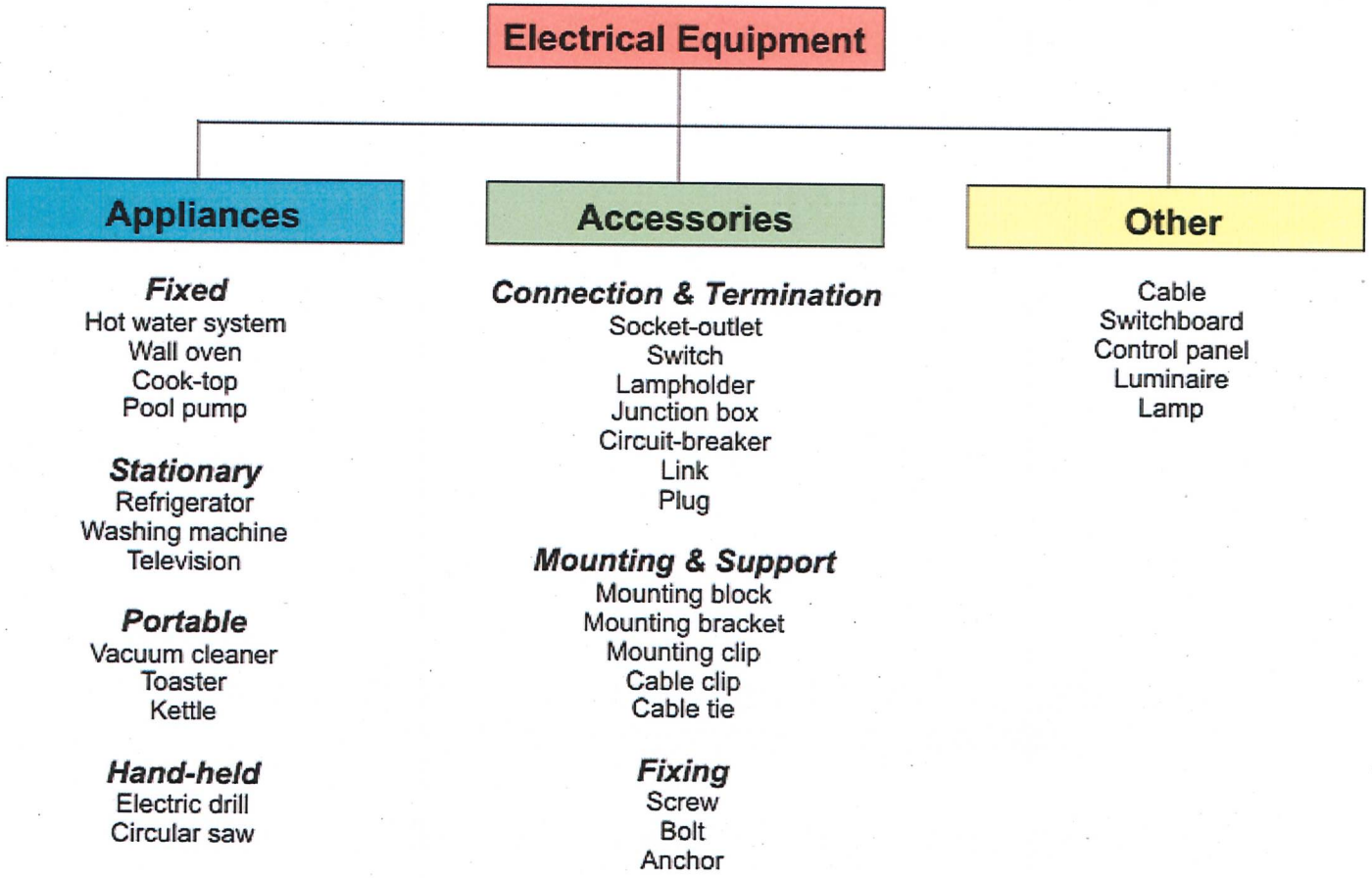
The dictionary defines an **accessory** as *"something nonessential but desirable that contributes to an effect or result"*.

Consider a 10A socket-outlet (better known as a power point). You could run your television without one of these, but it would mean running the cable directly into the TV cabinet. Also, you wouldn't be able to unplug it during a lightning storm.

Electrical accessories are a non-essential but desirable item that make the installation and use of electricity easier and safer.

Reference Click here to lookup the definition for *accessory* in **AS/NZS 3000 - Section 1, Clause 1.4.3** and summarise it in your own words.

You might find the following diagram useful in differentiating between items that **are** accessories and items that are **not**.



The following units cover the accessory sub-categories of **Connection & Termination**, **Mounting& Support** and **Fixing**. As you work through the units you'll be required to refer to manufacturers catalogues to look up information relating to accessories.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Accessories

Mark as done

Electrical Accessories

Accessories for Connection & Termination

Connection and **termination** accessories are designed to be directly connected to the circuit wiring. As such, they usually have specific electrical ratings assigned to them.

Voltage ratings include **250V** for ***single phase*** accessories and **440V** for ***three phase*** accessories.**Current** ratings vary depending on the type of accessory and it's application.

Some connection and termination accessories (e.g. socket-outlets, switches) are commonly known in the trade as "***Bakelite***". The term comes from the name of the material originally used to manufacture these items. These days **polycarbonate plastic** is used.

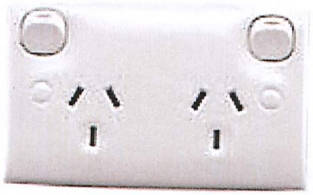
Most manufacturers have a number of different *"Bakelite"* ranges available in their catalogues, from standard accessories to those designed to fit in with old-style home interiors (e.g. Clipsal's ***Heritage*** range).

Socket-outlets

The usual method of connection for both stationary and portable appliances is by plug and socket-outlet. This allows simple connection and disconnection by the user.

There's a wide range of socket-outlets for different purposes, the most common being the **10A combination** (*combination* simply means that the socket-outlet has a switch incorporated into it, allowing it to be controlled). Another term for this accessory is a **switched socket combination**.

Single 10A combination



Double 10A combination

Single 15A combination

The socket-outlets above are all designed to take a standard 3-pin flat-pin plug.

Notice how the 15A outlet has a larger earth pin than the 10A outlet. That's because a **15A** plug has a **larger earth pin** than a 10A plug. This prevents it from being put in a 10A outlet, which would **overload** the outlet. A 10A plug can still be used in a 15A outlet.

Variations on the socket-outlets above include:

- **Combination with an additional switch** to allow control of a lighting point or an appliance (e.g. exhaust fan).

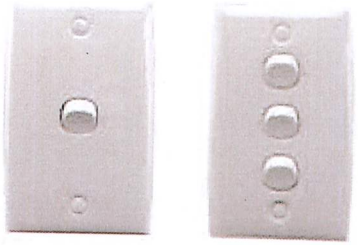
- **Outlet only** without control switch, used where it's preferable to have the switch located elsewhere.
- **RCD** (safety switch) built into the socket-outlet for protection against electric shock.
- **Surge protection** built into the socket-outlet to protect electronic equipment (e.g. computers).

In a later module you'll learn about a range of heavy duty socket-outlets designed for use in non-domestic environments.

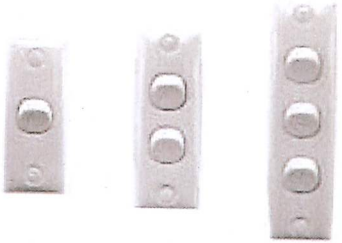
Switches

Switching accessories are many and varied and are usually categorised according to the following...

- The **size** of the switch plate, the two most common sizes being **standard pattern** (the same size as a power point) and **architrave**. The standard pattern switch usually mounts on a bracket, wall box or mounting block directly on the wall surface. An architrave switch is designed to mount on the timber trim around a door frame.
- The **current rating** of the switch contacts. The most commonly used rating is **10A**, although you can also get 15A, 20A, 25A and 32A switch mechanisms for a standard switch plate.
- The **ganging** arrangement, which refers to the **number of switch mechanisms** on the plate. **Multi-gang** switch plates are used where a number of control switches need to be located at the same point in an installation. A standard pattern plate can accommodate up to 6 switch mechanisms. An architrave plate can accommodate up to 4.



Standard pattern switches



Architrave switches

Other types of switching accessories include:

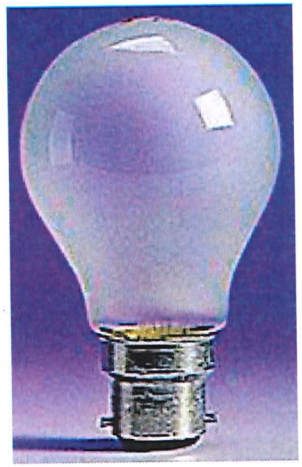
- **Dimmer switches** which allow lighting levels to be adjusted.
- **Fan controllers** for the control of ceiling sweep fans.
- **Split mechanisms,** allowing two separate switching functions from the same position on the switch plate.

Lampholders

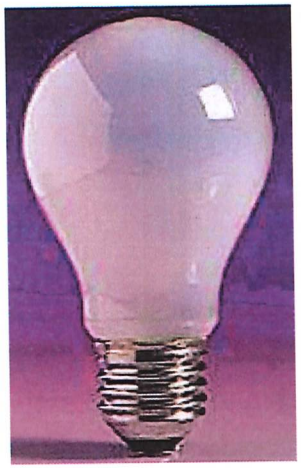
Lampholders are designed to allow **lamps** (light globes, fluorescent tubes, etc) to be changed easily.

The two common categories of **GLS** (General Lighting Service) lamp are:

- **Bayonet cap (BC)** - the lamp is inserted against spring terminals, then turned slightly clockwise to lock into position.
- **Edison screw (ES)** - the lamp has a screw thread and must be turned continuously in a clockwise direction to fit them.



Bayonet cap GLS lamp



Edison screw GLS lamp

Both of these are available in various sizes. You'll learn more about lamps in a later module specifically devoted to **Lighting**. For now, you only need to be able to identify a range of lampholders commonly used with these lamps.

The most common type of lampholder used in general wiring is the **battenholder**, so named because it was historically designed to be screwed to a timber **batten** in the ceiling. These days we rarely use battens in ceilings, with the battenholder being fixed directly to a ceiling joist or wall stud.

BC battenholder

ES battenholder

There are a number of variations on the lampholders shown above including adjustable types and those with safety shutters.

Other types of lampholder include:

- **Switched** lampholders commonly used on bedside lamps.
- **Cord grip** lampholders which are usually suspended from the ceiling on a flexible cord.
- **Festoon** lampholders used for festoon lighting systems (e.g. party lights).

Other Connection and Termination Accessories

Listed below are a range of other connection and termination accessories used for a wide range of functions...

- **Isolating switches** - used on switchboards to isolate individual circuits, or groups of circuits.
- **Protection devices** - circuit-breakers, fuses and RCD's, used on switchboards for the protection of circuits.
- **Bars and links** - used to provide a common connection between conductors at the same potential (e.g. circuit neutrals).
- **Junction boxes** - used to enclose cable joints.
- **Ceiling roses** - used to join the fixed wiring to a flexible cord.

Activity

Obtain a manufacturers catalogue (e.g. *Clipsal*, *HPM*) and identify the full name, catalogue number and trade price of the connection and termination accessories pictured in your workbook.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Electrical Accessories

Mark as done

Electrical Accessories

Accessories for Mounting and Support

Mounting and **support** accessories differ from connection and termination accessories in that they don't have electrical terminals that require connection to the circuit wiring.

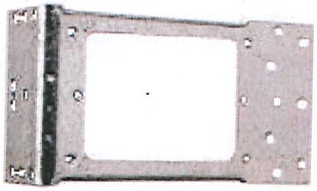
This makes them relatively inexpensive components, yet still necessary for the safe and reliable functioning of an electrical installation.

Mounting Accessories

A **mounting accessory** is an accessory that's typically used to facilitate mounting of a *"bakelite"* accessory, such as a switch or a socket-outlet.

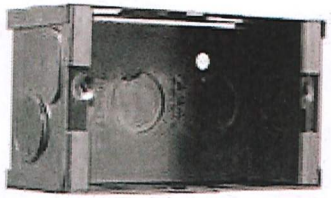
When performing new work, it's usually preferable to install cables inside walls or in the ceiling space so that they're out of sight. This type of wiring is said to be **concealed**. In these situations the bakelite accessories are usually **flush** mounted (i.e. they don't stick out from the surface).

Pictured below are some common accessories used for **flush** mounting situations...

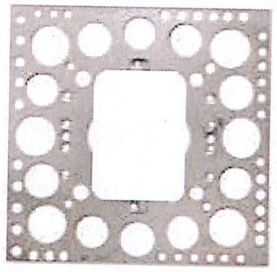


Horizontal mounting bracket (also called a stud bracket).
Used in new installations on hollow walls (e.g. Gyprock).
Also available in vertical orientation.

Mounting clip - used for flush mounting of accessories on existing hollow walls when it's not possible to install a stud bracket (due to the wall sheeting already being fitted).



Wall box - embedded in masonry walls for flush mounting of accessories.
Available in metal or PVC.

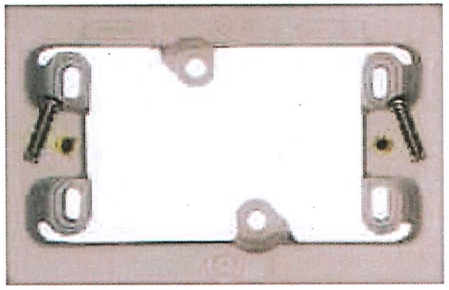


Plaster bracket - fixed to the surface of masonry walls and cement rendered over.

When running new circuits in existing installations, it's often difficult to install cables so that they're concealed. In these situations the cables are usually **surface wired**, either supported directly by clips or installed in a wiring enclosure which itself is supported.

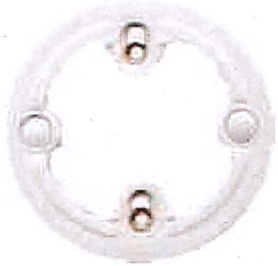
In these situations the bakelite accessories are mounted so that they **stand off** from the surface, allowing the wiring to enter from the side.

Pictured below are some common accessories used for **surface** mounting situations...

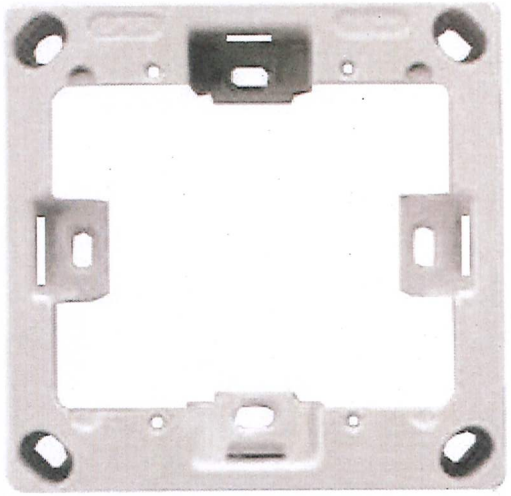


Mounting block - standard pattern (available in different depths)

Mounting block - single gang architrave pattern



Mounting flange - suits ceiling rose or battenholder

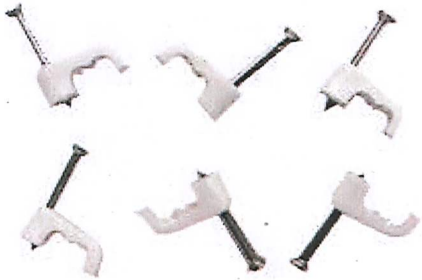


Mounting flange - double gang

Support Accessories

Support accessories are used to support cables directly, or to support wiring enclosures that house cables. Some common support accessories are pictured below...

Pin clips - brass



Cable clips - PVC

Conduit saddle (PVC)

Conduit saddle (metal)

Conduit half-saddle (metal)

Activity

Obtain a manufacturers catalogue (e.g. *Clipsal*, *HPM*) and identify the full name, catalogue number and trade price of the mounting and support accessories pictured in your workbook.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Ordering and Receiving Electrical Items

Mark as done

Ordering, Receiving and Dispatching of Materials and Accessories

Electrical Wholesalers

An electrical wholesaler provides electrical equipment, materials and accessories to the electrical industry. Before setting up an account with your local electrical wholesaler, it is **vital** that you **read** and **understand** the **terms and conditions** of that wholesaler. It is worthwhile visiting 2-3 wholesales to discuss their terms and conditions and the services they provide. The main electrical wholesalers found in the Hunter and surrounding areas include:

Their terms and conditions will include:

- **Payment options** 30, 60 or 90 days
- **Delivery** time-frames and handling charges
- **Failure to pay** invoice on time and associated additional charges
- **Repossession** of electrical items not paid at the business's premise
- **Legal action** for reclaiming money owed

Click here for Lawrence and Hanson's 'Terms and Conditions'.

Once the approval process is completed you can start ordering items immediately in person. Online accounts usually take 3-5 business days to establish.

◀ Transformer Principles and Operation

Jump to...

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E141 / E179 - Identify and Use Electrical Devices (Hunter)

Ordering and Receiving Electrical Items

Mark as done

Ordering, Receiving and Dispatching of Materials and Accessories

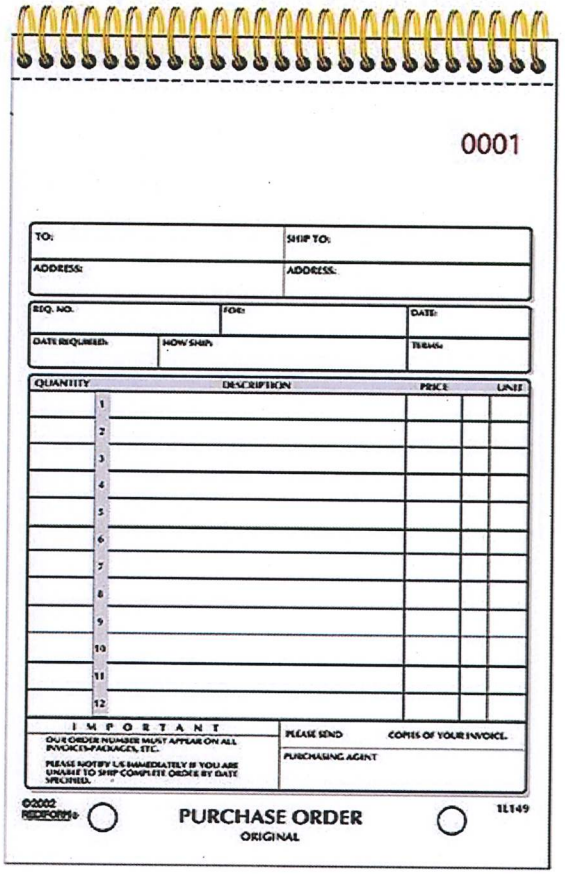
Why use a Purchase Order?

No matter the size of the electrical business, it is important that purchase orders be used by **all** employees if ordering materials and accessories.

Purchase orders are a legal binding document sent from an electrical business to an electrical wholesaler with a request for purchasing electrical items. They can either be in a electronic format or paper based.

The purchase order should include at a minimum:

- ***Type of electrical materials and accessories*** - description and/or part number.
- ***Quantity*** - Whether ordering items in individually or in bulk.
- ***Date*** - Shows the date the purchase of the electrical items took place.
- ***Pick-up or delivery address*** - **Clarifies if the employee received the electrical items or if they are being delivered to a particular job.**
- ***Date of delivery and time*** - Determines if the goods need to be delivered at a certain date and time.
- ***Job number*** - This number represents the customer job the electrical items are being purchased against.
- ***Authorised signature*** - Able to track the employee who authorised the purchase of the items.



For **specialised orders** it is also important to include the cost of the item. This provides a confirmation of price agreement prior to receiving the specialised electrical item.

Utilising a purchase ordering book with a structured process has the key advantages:

- **Able to allocate purchased electrical items to specific jobs** - This shows whether a particular job is running under or over budget
- **Pickup/deliver confirmation** - Have the means to revise how the materials were ordered for internal business tracking
- **Employees are <u>unable</u> to purchase items for their own personal needs** - This reduces the chance of employees *stealing* from the business
- **Purchase orders are legally binding documents** - The contractual nature of a purchase order protects both the buyer and the supplier in case of a dispute about the nature of the order and/or price.

E141 / E179 - Identify and Use Electrical Devices (Hunter)

Ordering and Receiving Electrical Items

Mark as done

Ordering, Receiving and Dispatching of Materials and Accessories

Ordering Online or in Person

The majority of electrical wholesalers offer the choice of ordering electrical items either **online** or **in person**. There are benefits to both types of ordering and usually a combination of both will occur regularly.

Monthly invoice statements are either posted or sent electronically to your nominated email address for monthly payment and taxation purposes. Most new electrical businesses will start on a **30 day** payment option, this may increase to **60** or **90 days** dependant on:

- *Volume of items purchased*
- *Total value of items purchased*
- *Regular payments made within the current payment option*

Note: Some wholesalers offer the flexibility of downloading the last 12 months invoices in electronic format for taxation purposes.

Ordering online

Once an online account has been established ordering online can occur. This is a simple process of clicking on the materials and accessories and the amount required. The items are then added to you shopping cart for final verification and approval. The shopping cart will also detail the GST and shipping costs. Once purchased you are able to view and print the invoice.

The benefits of ordering online:

- An **Extensive Product Catalogue**, complete with your pricing
- The ability to **create favourite lists**
- The capacity to order **outside of business hours**

Click here for an example of selecting materials using online ordering.

In Person

Having good communication with your chosen electrical wholesaler is vital for running a successful business.

The benefits of ordering in person:

- **Clarification** on the type of material or accessory **prior to purchasing**
- Able to have a **technical discussion** prior to implementation
- Ability to order **non standard** materials and accessories

◀ Transformer Principles and Operation

Jump to...

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E141 / E179 - Identify and Use Electrical Devices (Hunter)

Ordering and Receiving Electrical Items

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Ordering, Receiving and Dispatching of Materials and Accessories

Receiving Electrical Items

A clear process is required for ensuring all electrical items delivered either to the business address or directly to a customers address are accounted for and can be traced. The most common issues surrounding deliveries are over or under deliveries, damaged or incorrect items. There are a few things which can be done to reduce your risk and liability.

As mentioned earlier in this section purchase orders are vital for tracking items. If items are being delivered, the purchase order needs to include a **delivery address, date required, contact details, items** and **quantity.**

Taking Delivery

If receiving electrical items which are heavy or bulky ensure the wholesaler is clear about the delivery date and exact location within the property to minimise confusion and double handling of the items. Also it is important that there is adequate space for the items being delivered including access for the delivery.

Damaged goods

When electrical items are delivered check as much as possible for defects whilst the delivery person waits, if they are in a hurry only sign the delivery note if you can also write **"unchecked"**.

If boxes look as though they are damaged you have two options:

1. *Refuse the delivery*
2. *Accept the delivery, make the delivery person aware and sign for the goods clearly writing **damaged** on the delivery paperwork*

In both situations, the electrical wholesaler needs to be notified preferably via a **phone call** and followed up with an **email**. If the electrical wholesaler arranged the delivery, the wholesaler is responsible for dealing with the problem and have a ***contractual responsibility*** to supply items which are of satisfactory quality.

Quantity Discrepancies

It is difficult if taking delivery of large quantities of items; to ensure that you do indeed have the correct number. On these occasions the delivery person will not usually wait whilst you count all the items. If you sign the delivery note **"Unchecked"** you have an opportunity to claim if the incorrect quantity has been delivered. The law allows purchasers **"A reasonable amount of time"** to check deliveries and report faults. It is therefore imperative that deliveries are fully checked as soon as is possible.

Any discrepancies, no matter how minor, should be reported immediately to the supplier.

If you have received above the amount you ordered, the wholesaler must collect the extra items. The Wholesaler may offer to let you keep these items free of charge, especially if they are of a low value. They may also offer to sell you the extra product, often with the promise of a deferred invoice. <u>You are under no obligation to accept either offer.</u>

If you receive less than the amount you ordered:

1. You may only **cancel the balance** if you inform the supplier immediately that the remaining quantity is of no use to you due to the delay
2. You may ask the supplier to **deliver at your convenience**

Incorrect Items

If the items match the purchase order and you have just simply purchased the wrong items or ordered the incorrect quantity, it will be down to whether the wholesaler is willing to assist. The Wholesaler has no legal requirement to accept back items which you have ordered. However they may be willing to do this if you are a regular customer or will accept a restocking fee. In situations like this each case is individual and will need to be negotiated.

If the goods do not match your purchase order:

1. You may **reject the delivery** and request a re-delivery within a reasonable amount of time.
2. You may **accept the goods**

Storing of Items Purchased

Whether electrical items are delivered on-site or at the business address they need to be stored correctly with the primary focus towards work health and Safety (WHS) and clear identification of items for future use. Any task which involves **lifting, lowering, pushing, pulling, carrying, moving, holding or restraining** can be hazardous. An object does not need to be heavy to pose a risk. Sometimes, the simple motion of lifting an item and then turning to place it somewhere can result in permanent injury.

V Lifting and Carrying - Video

◀ Transformer Principles and Operation

Jump to...

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